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Research Articles

Intradialytic Exercise (IDE) for CICU Patients in Heart Hospital -A Quality Improvement Program

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Abstract

Problem statement: The rehabilitation of patients receiving dialysis plays an extension of healthy life expectancy. However, the consecutive rehabilitation interventions are difficult to implement due to worsening of physical conditioning or time constraints among patients undergoing dialysis. Reduced kidney efficiency is linked to a progressive deterioration in cardiovascular health, ultimately leading to heart failure, myocardial infarction, and stroke [1]. Currently, efforts to exercise during dialysis are increasing from the viewpoint of continuity and efficiency of exercise [2]. Comprehensive interventions are necessary due to the complex nature of patients in the CICU. Muscle atrophy is associated with poor physical performance [3].

Aim: "To implement Intra dialytic exercise (IDE) to ≥ 95% of patients undergoing dialysis (between the 1st and 2nd hours) in Coronary Intensive Care Unit (CICU) by November 2021".

Interventions: A staff survey was conducted to assess the need for IDE program in the CICU. An evidence-based IDE protocol was created for HD patients. All the HD patients aged above16 years both male and female genders in the CICU were screened for eligibility for the IDE program. Then, the IDE protocol was initiated for hemodynamically stable patients along with mobilization and at least two exercise sessions per week. Based on each patient's level of mobility, the IDE protocol was implemented. Supine cycle ergometer in the CICU made patients actively involved in the IDE program. The ICU mobility scale was used to measure the progression.

Results: The total number of patients included in the project from 1st March to Nov 2021 was 84, including both males and females. In May 2021, 50% of patients were included in the project. In July 2021, 66.6% of patients were included. Then, in August, the proportion reached to 100%. As a result of this program, more than 95% of patients participated in the IDE program by November 2021.

Conclusion: It is feasible to implement the IDE program among CICU patients after screening patients using a customized protocol.

Keywords: Intradialytic Exercises; Kidney Failure; Critical Care Patients; Quality Improvement Program

Abbreviations

IDE: Intradialytic exercise; CICU: Crictical intensive care unit; HD: Haemodialysis; 6mwd: 6minute walking distance; PDSA: Plan-do-study-act; QI: Quality improvement; MDT: Multidisciplinary team

Introduction

Intradialytic exercise, which is exercise performed during hemodialysis treatment, has emerged as a promising method for improving the physical and mental wellbeing of patients undergoing dialysis for end-stage renal disease. Hemodialysis is a life -sustaining treatment that can promote a sedentary lifestyle, thus leading

to decreased physical activity, muscular weakness, and depression. The rehabilitation of patients receiving dialysis plays an important role in the extension of healthy life expectancy or improvement of life prognosis. Reduced kidney efficiency is linked to a progressive deterioration in cardiovascular health, ultimately leading to heart failure, myocardial infarction, and stroke [1].

However, consecutive rehabilitation intervention is difficult due to worsening of physical conditioning or time constraints in patients on dialysis.

Patients undergoing dialysis are in the supine position for 3–4 hours at a time, 2–3 days a week. As a result, a vicious circle is created in which chronic inactivity results in decreases in physical fitness and physical function, which leads to further inactivity [1].

Regarding exercise during dialysis, various strategies, such as ergometer exercise (supine position ergometer exercise) have been utilized, and it has been reported that patients on hemodialysis have muscle atrophy. Furthermore, an association between muscle atrophy and frailty has been found. A survey in patients with sarcopenia showing age-related muscle decrease showed that sarcopenia is associated with low survival rates [2,3].

Moreover, a study reported that 22.2% of hemodialysis outpatients have sarcopenia, and this rate was 48% among patients aged >70 years. Continuous exercise and an increase in physical activity are necessary to prevent or mitigate the decrease in physical strength among patients on dialysis and to put an end to the vicious cycle.

Problem statement

Comprehensive interventions are required due to the complex nature of patients in the coronary intensive care unit (CICU), which can lead to prolonged periods of bed rest with limited mobility. Implementation of intradialytic exercise during dialysis can increase the continuity and efficiency of exercise [3]. However, implementing IDE as a standard of care remains challenging in practice. IDE programs can cause positive patient outcomes that can attenuate the effects of immobility and enhance functional independence.

Rationale

Intradialytic exercise can also improve cardiovascular function. Regular exercise has been shown to improve cardiovascular health by decreasing blood pressure, improving heart rate, and reducing the risk of cardiovascular disease. These benefits are especially important for dialysis patients, who are at high risk of cardiovascular disease due to factors such as high blood pressure, diabetes, and hyperlipidaemia [36].

Although exercise during dialysis has benefits and advantages there are times when an exercise session is skipped on the day of HD, especially when patients are tired after the HD session, thus delaying a patient's functional independence at the time of discharge. Intradialytic exercise can easily reduce the time of inactivity during bedtime dialysis, and because it can be performed at regular dialysis time, continuing the exercise is easy. As a result, improvements in oxygen uptake and walking ability have been reported [4]. The CICU multidisciplinary team identified a need for a quality improvement (QI) project to implement Intradialytic exercise in patients during HD sessions.

Setting

The CICU is a 20-bed unit that serves complex adult cardiac patients at Heart Hospital, Hamad Medical Corporation in Doha, Qatar.

Methodology

Quality improvement (QI) is a systematic, formal approach to the analysis of practice performance and efforts to improve performance. IHI uses the Model for Improvement as the framework to guide improvement work - a simple, yet powerful tool for accelerating improvement. The Model for Improvement focuses on testing changes on a small-scale using Plan-Do-Study-Act (PDSA) cycles. Filling the gap between research and clinical practice requires the use of structured multistep quality improvement efforts. One such quality improvement approach is the Translating Research into Practice model.

Preparation phase

A multidisciplinary task force team was formed that included physicians, CICU nurses, dialysis Nurse and physiotherapists. A staff survey questionnaire was prepared and sent via email to all the staff in the CICU. The needs assessment survey was conducted, and the information obtained from the survey was analyzed. The data from the survey revealed that no such IDE program had been conducted before in the CICU.

Everyone understood the importance and agreed that there is a need to implement IDE programs for patients in the CICU. Baseline data collected from Nov 2020-Mar 2021 from the CICU through our PT team showed that there is a space for implementing the IDE program. There is no specific protocol available for CICU patients; hence, our team decided to prepare a specific protocol. We searched

currently available evidence, scrutinized the articles based on the Pedro score, and selected articles with a score of 6 and above to design the IDE protocol. The prepared IDE protocol was sent to all staff members for review and feedback. Finally, the protocol was sent to our superiors, who approved it and added valuable comments. Before implementing the protocol, we consulted our senior consultant nephrologist, who also provided ideas and supported in design of an evidence -based IDE protocol [26-29]. (Appendix-2) for our patients on Dialysis.

Appendix 1

Staff education and training were conducted at multiple stages so that they could become familiarized with the IDE protocol, a number of unit meetings were conducted to identify barriers, and MDT meetings were conducted every month to explore ideas. A WhatsApp group was created, which facilitated communication among our team members. We asked HD nurses to provide details of patients who are undergoing HD on a day-to-day basis. As soon as the list was obtained, the CICU nurses assessed whether the patients were eligible for the PT referral; if not, the physicians were asked to raise the referral for physiotherapy. Once the referral was provided, the physiotherapist assessed the patient for eligibility based on the screening factors. Based on the level of mobility the IDE protocol was implemented.

Appendix 2

Daily shift huddles were conducted through online due to COVID restrictions. Every Tuesday morning at 7:30 am, CICU huddles were conducted, where we discussed the progression of our program through graphical representation on the VIP board. The experts provided their suggestions for improvement whenever a dip in the program was observed.

Inclusion criteria [25]

- BP from 180/100 mmHg to 100/50mmHg.
- Resting HR <100 bpm
- Properly functioning CVC or adequate needling of AVF or AVG
- No abnormal symptoms (cold, flu, headaches, dizziness, nausea, etc.)
- The National Kidney Foundation Kidney Disease Outcomes Quality Initiative guidelines for optimal haemoglobin are 11 to 12 g/dL. Patients with more complex cardiac histories may need to be put on hold until their haemoglobin improves.
- Blood sugars are controlled (between 7 and 14 mmol or 126 and 252 mg/dL)
- Oxygen saturation levels at rest should be above 90% and remain above 88% during exercise without symptoms.

Exclusion criteria [28]

- American Heart Association/American College of Sports Medicine Joint Position Statement: 1) unstable ischaemia; 2) heart failure that is not compenstated;3) uncontrolled arrhythmias; 4) severe and symptomatic aortic stenosis; 5) hypertrophic cardiomyopathy or cardiomyopathy from recent myocarditis; 6) severe pulmonary hypertension; or 7) other conditions that could be aggravated by exercise (for example, resting systolic blood pressure >200 mmHg or resting diastolic blood pressure >110mm Hg; active or suspected myocarditis or pericarditis; suspected or known dissecting aneurysm; thrombophlebitis and recent systemic or pulmonary embolus).
- Physical limitations that would affect usage of the bike
- Poor blood sugar control
- Active infection or illness
- Poorly functioning CVC or AVF/AVG patients suffering from unstable angina or orthopaedic or musculoskeletal problems interfering with exercise training were excluded.

Based on the inclusion and exclusion criteria we identified screening factors specifically for our patient populations.

Barriers

The MDT has identified the barriers before implementing the project, and the barriers were grouped into four categories.

Patient Related barriers.,2. management -related barriers.,3. clinical staff -related.,4. equipment/task -related.

- **Patient:** Related barriers included a culture of laziness, lack of awareness about exercises, lack of motivation and poor lifestyle of labour patients. Most of the patients sleep during dialysis. End- stage renal disease patients and their hemodynamic instability are the major barriers. Mood -related factors, uraemia, fatigue, and anaemia, fluctuating blood pressure, ionotropes, frequent dizziness, and fluid overload are also barriers.
- **Management:** Related barriers include delays in physiotherapy (PT) sessions, lack of standard protocols, lack of coordination among the staff members, and management of exercise sessions after duty hours.
- **Clinical staff:** Related barriers include concerns about adverse effects, lack of time and being too busy in the CICU. A lack of manpower is also one of the major barriers. Additionally, the unavailability of physiotherapists after duty hours was also a barrier.
- **Equipment/task:** Related barriers include equipment handling issues, such as the heavy equipment and space to set up the machine inside the patient room, the usage and storage of the equipment, the invasive line positioning during HD and frequent alarming if there is any movement of the lines and tubes, catheter misplacement or dislodgement.

After identifying the barriers, we performed Pareto analysis to find major barriers based on the 80/20 principle.

The three major barriers identified to implementing the project are hemodynamic instability, lack of standard protocol, and lack of physician order.

Initial screening factors were identified based on current evidence; therefore, we chose hemodynamically stable patients. A customized IDE protocol framed according to our patient populations facilitated a novel approach and promoted the consistency of mobilization practices in the CICU.

Implementation phase

The project officially launched on 7th March 2021, when patients were screened for eligibility for the IDE program.

We prepared the IDE protocol according to the patient's level of mobility. We designed this IDE protocol for both nonventilated and ventilated patients. The nonventilated patients will fall between levels 1 and 3 of mobility, whereas the ventilated patients fall under level of mobility 0, which includes stages 1,2 and 3.

The flow chart clearly explains the flow of patients when they enter the program, the level at which they will enter, and how they can progress to other levels. Since we implemented the early mobility protocol, it has become easy for us to combine ventilated and nonventilated patients. This is the first protocol in Qatar developed for CICU patients, mainly haemodialysis patients.

We monitored the patient's blood pressure and heart rate and adjusted the exercise program as needed to ensure the patient's safety and comfort. There were no adverse events encountered when we implemented the program. For example, the dialysis line should be secured carefully without disturbing the tubes and lines. Most patients have their permcath near the shoulder; hence, we avoided exercises that worked the upper extremity on that side. Lower extremity and opposite upper extremity exercises were assigned. Our nursing counterpart has played a major role in implementing this program, especially our HD nurses' team, which has played a significant role in implementing the program. The IDE protocol with mobilization and activity was implemented for hemodynamically stable patients twice weekly. Supine cycle ergometer made patients actively involved in IDE program. Documentation of different levels of IDE and outcomes emphasized among the staff members.

Aim

The aim of this program was to implement intradialytic exercise (IDE) to ≥95% of patients during dialysis (between the 1st and 2nd hours) in the coronary intensive care unit (CICU) by November 2021.

Figure 1

Figure 2

Change ideas implemented through PDSAs

We tested the feasibility of the newly developed intradialytic standard exercise protocol in one patient who was fully conscious with a RASS score of '0'. The patient was conscious and obeyed commands; hence, it was easy for us to explain the program to the patient who understood the importance of intradialytic exercises and cooperated well. As per the screening factor, his eligibility for the program was confirmed, a scale was administered to assess his fatigue level. According to flow chart, he fell under the category of adaptive phase 2 and exercises were assigned. HR, BP, saturation, and hypotension episodes were monitored. Safety precautions were ensured before initiating the protocol.

We tested the feasibility of the newly developed intradialytic standard exercise protocol in one patient whose RASS score is <-2. The patient awakened briefly and responded to verbal commands as the sedation level decreases. As soon as he responded slowly, he started with acutephase-A1 and progressed to A2.

We tested the feasibility of the newly developed intradialytic standard exercise protocol in both mechanically ventilated and non-mechanically ventilated patients with RASS scores of 0 to -4. As this program extended to a wider population, we were not able to achieve the predicted goal. Then, we reviewed our screening factors to include more stable patients. Although our plan is to implement the programme for all patients initially, we find it difficult to implement it for all patients due to many factors. Then, we adapted the changes we tested while we were implementing the program.

Physiotherapists should coordinate with HD nurses to obtain a daily HD patient list in the CICU and coordinate with CICU physicians and nurses to initiate PT consultations.

Physiotherapists should coordinate with occupational therapist regarding patients' refusal to complete assessments or participate in the IDE program. The reasons for refusal were collected, and patients and their family members were educated about the protocol.

Results

The total number of patients included in the project from 1st March to Nov 2021 was 84, including both males and females. In May 2021, 50% of patients were included in the project. In July 2021, 66.6% of patients were included. Then, in August, the proportion reached 100%. As a result of this program, more than 95% of patients underwent IDE before November 2021.

As a balancing measure, The Patient Experience Survey was conducted, and 92% of patients felt that this program was helpful in their recovery and enjoyed the bed cycle during HD. ICU mobility scale was used to measure the progression of function at different levels of the protocol.

There was no significant difference in the ICU mobility scale scores between pre implementation and post implementation of the IDE program. This may be due to the implementation of the early mobility protocol prior to the implementation of the IDE program which would have masked the difference.

Initially, when the program was implemented, 100% success was achieved within a few weeks. When the program was expanded to a wider population, more time and more PDSAs were needed to achieve the target.

It is very well observed in the run chart. The most difficult part of the program is handling patients who are refusing the IDE program. This issue was addressed by consulting our Occupational therapy colleagues.

Figure 3

Figure 4

Discussion

Intradialytic exercise has been shown to have a variety of benefits for dialysis patients. First and foremost, it can improve physical function and reduce muscle wasting. Regular exercises have been shown to stimulate muscle protein synthesis, increase muscle mass, and improve muscle strength. These physical benefits are especially important for dialysis patients, who are at risk for muscle wasting and weakness due to the sedentary nature of dialysis and other factor such as anaemia, malnutrition, and inflammation.

If patients meet the safety criteria, the staff can bring a pedal bike in front of their chair to use within the first 2 h of the dialysis treatment. All new participants start with a perceived exertion of ''easy'' on the RPE 6-20 Borg Scale. During the first 2 h of dialysis (three times a week), 55% to 70% of age predicted maximum HR a "moderate" RPE. Patients are encouraged to progress towards a goal of 30 to 40 min.

The most popular exercise is with a cycle ergometer placed in front or at the foot end of the bed, either in 2 X10 min sessions or continuously, and the HR, BP, RPE, and symptoms are monitored. According to the protocol, the supine cycle mode progressed from passive mode to active assisted mode and then to resistive mode.

According to Barany, P., Berne, C.2015, intradialytic exercise must be performed under close supervision in the ICU. The type and intensity of exercise will depend on the patient's medical condition and overall health status. Some ICU patients may not be able to perform physical activity or low intensity exercises.

One to two sets of 12 to 15 repetitions (or 60% to 70% one repetition maximum calculated from 10 RM test) is appropriate. The use of Thera bands, dumbbells, weight cuffs, etc is also useful. Resistance training is possible during dialysis and can include the nonfistula arm or both if the patient has a well-functioning central venous catheter (CVC).

Patients should hold stretches to "light tension" for 20 to 30s. The total body routine should take 10 minutes. Static and dynamic balance exercises are recommended to be performed on most days of the week among patients at risk for fall.

Konstantinidou., *et al*.,2002, recommended a combination of exercise training for 30 min with a bed bicycle ergometer and performing 30 min exercises for strength and flexibility until 70% of max heart rate is achieved.

Painter., *et al*., 2002 reported better results with cycling for 30 min; they found a Borg Rating of Perceived Exertion (RPE) scale of 12-14.

Participants self-progress their exercise duration by 2 to 5 min per session with the goal of achieving at least 30 min of exercise during each dialysis session. After the ''easy'' 5-min warm-up, a ''moderate'' to ''somewhat hard'' pace is encouraged. Vitals are measured preexercise, midexercise, and again 2 min postexercise.

Preexercise, and postexercise oxygen saturation values are measured in all patients, and preexercise and post exercise blood glucose levels are monitored in diabetic patients.

The Borg scale is highly recommended for monitoring exercise intensity because HD patients commonly take beta-blockers and may have fluctuations with their day-to-day fluid gains, energy levels, and symptoms.

Patients with a history of hyperkalemia or hypokalemia may require at least 30 min of HD to lower the risk associated with these acute conditions prior to commencing exercise.

As intradialytic hypotension is a potential risk during HD, susceptible patients may need longer cool-downs.

Bed cycling should be encouraged in those who tend to develop cramps during their treatments (assuming they meet the criteria for safe exercise), as such exercise may prevent or reduce the severity of cramping.

Safety monitoring (renal association) [32].

- Prior to exercise, ask the patients how they feel, record last measured intradialytic blood pressure and heart rate.
- During exercise, ask patient to report symptoms of pain, excessive fatigue, altered consciousness, overheating, anxiety, severe breathlessness, chest pain, and dizziness/light-headedness.
- Rating of perceived exertion scale can be used during exercise to monitor intensity and ensure exercise intensity does not provoke response greater than 15/hard (heavy) on the Borg RPE scale.

Flow chart: (Appendix-3)

Regular exercise significantly improved the physical fitness (aerobic capacity), cardiovascular dimensions (resting diastolic

Appendix 3: Flow chart.

and systolic blood pressure), nutritional parameters (albumin, prealbumin), and health-related quality of life of a person [5].

Intradialytic exercise training has beneficial effects on HD patients' cardiorespiratory capacity. Significant improvements in physical capacity (VO2peak), physical performance (6-MWD, STS-60), and self-reported physical functioning (PCS of SF-36)[6] were observed.

Intradialytic exercise may reduce the mortality risk of HD patients and improve their quality of life [7].

The intensity, duration, and modality of exercise varies across studies, but all regimens included at least 30 min of moderate activity three times per week for at least 8 weeks, except for one study, which only include training twice per week [8].

A patient's eligibility for exercise, is based on their medical history, physical examination, electrocardiographic testing, and laboratory examination.

If applicable, physiotherapists can design a prescribed program of progressive exercise, including a 5-10 min of warm-up period of training. The intensity of exercise should be prescribed on an individual basis using the rate of perceived exertion (RPE) of the Borg 6-20 scale [9,10].

It seems that any intensity, duration, and modality of intradialytic exercise is effective, but comparative studies are needed to determine the optimal exercise regimen [11].

A variety of training modalities (cycling, resistance exercise, and electrical muscle stimulation) have been shown to exert numerous benefits and negligible complication rates [13,14,16-19]. In a study by Christoford. D Giannaki, all patients responded well to prolonged exercise and expressed better muscular performance during and after exercise, and all patients reported improvements in the Kt/V and URR indices after physical exercise compared to exercise free time [33].

Exercise during dialysis treatment is safe and leads to either better psychophysical performance or better dialytic efficiency [23].

Limitations

- This is a quality improvement project, and there is no control group.

- This study had a small sample size; to increase the generalizability of these findings, more populations need to be tested in different ICU setups.
- The IDE protocol is customized for our patient population.
- Multiple interventions have been conducted, but it remains unclear which intervention has the best efficacy.

Conclusion

Implementing the IDE program in the coronary ICU within the 1st and 2nd hours of HD is feasible. The IDE program would assist patients in regaining functional independence in the CICU. It may enhance the patient experience, accelerating the recovery process in the CICU. A standardized IDE protocol can facilitate a novel approach and promote consistency of mobilization practices in the CICU.

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